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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 84.

B. T. GALLOWAY, *Chief of Bureau.*

THE SEEDS OF THE BLUEGRASSES.

I. THE GERMINATION, GROWING, HANDLING, AND ADULTERATION OF BLUEGRASS SEEDS.

By EDGAR BROWN, *Botanist in Charge of Seed Laboratory.*

II. DESCRIPTIONS OF THE SEEDS OF THE COMMERCIAL BLUEGRASSES AND THEIR IMPURITIES.

By F. H. HILLMAN, *Assistant Botanist, Seed Laboratory.*

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BUREAU OF PLANT INDUSTRY.

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Pathologist and Physiologist, and Chief of Bureau.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., July 15, 1905.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 84 of the series of this Bureau the accompanying technical paper entitled "The Seeds of the Bluegrasses."

This paper was prepared by Mr. Edgar Brown, Botanist in Charge of the Seed Laboratory, and Mr. F. H. Hillman, Assistant Botanist, Seed Laboratory, and has been submitted with a view to publication.

The bluegrasses are among the most important forage plants in many sections of the United States and Europe, and large quantities of seed are harvested annually for use in this country and for exportation.

The process of cleaning the seed of the bluegrasses for market is such that many of the distinguishing characters are lost, and separate descriptions are necessary for the hand-picked and commercial seed of the same species.

The seeds of the different commercial species are so nearly alike in general appearance that at present none but the trained observer can distinguish between them. This similarity of appearance has encouraged the use of the cheaper and less desirable species, especially Canada bluegrass, for the adulteration of or substitution for the more expensive species.

The descriptions and illustrations herewith given of the bluegrasses and of their impurities will be of great value in furnishing seedsmen the necessary information to enable them to distinguish the different species.

The accompanying illustrations are necessary for a complete understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

Page.

I. The Germination, Growing, Handling, and Adulteration of Bluegrass Seeds. By Edgar Brown 9
Description of commercial and hand-gathered seeds 9
Grades and quality of commercial seeds 10
Adulteration 10
Weight per bushel 11
Germination 12
Growing and handling 12
Poa pratensis (Kentucky bluegrass) 12
Poa compressa (Canada bluegrass) 13
Poa trivialis (rough-stalked meadow grass) 13
Poa nemoralis (wood meadow grass) 13
Poa triflora (fowl meadow grass) 13
Poa arachnifera (Texas bluegrass) 14
Poa annua (annual bluegrass) 14
Poa alpina (alpine meadow grass) 14
Poa sudetica 14

II. Descriptions of the Seeds of the Commercial Bluegrasses and Their Impurities. By F. H. Hillman 15
The bluegrasses 15
Key to the seeds of the more common species of Poa as found on herbarium specimens 18
Key to commercial bluegrass seeds after preparation for market 19
Comparison of the principal distinguishing characters of bluegrass seeds 20
Descriptions of species 22
Poa pratensis L., Kentucky bluegrass, June grass 22
Poa compressa L., Canada bluegrass, flat-stemmed bluegrass 24
Poa trivialis L., rough-stalked meadow grass 24
Poa nemoralis L., wood meadow grass 26
Poa triflora Ehrh. (*P. flava* L., *P. serotina* Ehrh.), fowl meadow grass, false redtop 27
Poa arachnifera Torr., Texas bluegrass 28
Poa annua L., annual meadow grass 29
Poa alpina L., alpine meadow grass 29
Poa sudetica Haenke 30
Panicularia spp 31
Panicularia nervata (Willd.) Kuntze, nerved manna grass, sometimes called fowl meadow grass 31
Panicularia americana (Torr.) MacM., reed meadow grass, water meadow grass, tall manna grass 31

II. Descriptions of the Seeds of the Commercial Bluegrasses and Their Impurities—Continued. Page.
Weed seeds commonly found with commercial bluegrass seeds 32
Bursa bursa-pastoris (L.) Britton, shepherd's-purse 32
Lepidium virginicum L., peppergrass 32
Cerastium vulgatum L., mouse-ear chickweed 32
Alsine media L., common chickweed 32
Alsine graminea (L.) Britton 33
Carduus arvensis (L.) Robs., Canada thistle 33
Taraxacum taraxacum (L.) Karst., dandelion 34
Matricaria inodora L., scentless camomile 34
Hieracium sp., hawkweed 34
Anthemis cotula L., dog fennel, mayweed 35
Chenopodium album L., lamb's-quarters, pigweed 35
Plantago lanceolata L., rib-grass, buckhorn, English plantain 35
Rumex crispus L., curled dock 36
Rumex acetosella L., sheep's sorrel, sorrel 36
Veronica arvensis L., corn speedwell 36
Juncus tenuis Willd., slender rush 37
Juncoides campestre (L.) Kuntze, field rush 37
Juncoides albida DC., wood rush 37
Carex cephalophora Muhl., oval-headed sedge 37
Ergot occasionally found in commercial bluegrass seed 38
Claviceps purpurea (Fr.) Tul., ergot 38

ILLUSTRATIONS.

TEXT FIGURES.

Page.

FIG. 1. A spikelet of Poa 15
2. Unrubbed Kentucky bluegrass seed (*Poa pratensis*) 17
3. Seeds of Kentucky bluegrass (*Poa pratensis*) 18
4. Different forms of commercial seeds of Kentucky bluegrass (*Poa pratensis*) 22
5. Commercial seeds of Canada bluegrass (*Poa compressa*) 24
6. Seeds of rough-stalked meadow grass (*Poa trivialis*) 25
7. Seeds of wood meadow grass (*Poa nemoralis*) 26
8. Seeds of fowl meadow grass (*Poa triflora*) 27
9. Seeds of Texas bluegrass (*Poa arachnifera*) 28
10. A cluster of Texas bluegrass seeds matted by the webby fibers 29
11. Seeds of annual meadow grass (*Poa annua*) 29
12. Seeds of alpine meadow grass (*Poa alpina*) 30
13. Seeds of *Poa sudetica* 30
14. Seeds of nerved manna grass (*Panicularia nervata*) 31
15. Seeds of water meadow grass (*Panicularia americana*) 31
16. Seeds of shepherd's-purse (*Bursa bursa-pastoris*) 32
17. Seeds of peppergrass (*Lepidium virginicum*) 32
18. Seeds of mouse-ear chickweed (*Cerastium vulgatum*) 32
19. Seeds of chickweeds (*Alsine media* and *A. graminea*) 33
20. Seeds of Canada thistle (*Carduus arvensis*) 33
21. Prickles often found with bluegrass seed 33
22. Seeds of dandelion (*Taraxacum taraxacum*) 34
23. Seeds of scentless camomile (*Matricaria inodora*) 34
24. Seeds of hawkweed (*Hieracium* sp.) 34
25. Seeds of dog fennel (*Anthemis cotula*) 35
26. Seeds of lamb's-quarters (*Chenopodium album*) 35
27. Seeds of rib-grass (*Plantago lanceolata*) 35
28. Seeds of curled dock (*Rumex crispus*) 36
29. Seeds of sorrel (*Rumex acetosella*) 36
30. Seeds of corn speedwell (*Veronica arvensis*) 36
31. Seeds of slender rush (*Juncus tenuis*) 37
32. Seeds of field rush (*Juncoides campestre*) 37
33. Seeds of wood rush (*Juncoides albida*) 37
34. Seeds of sedge (*Carex cephalophora*) 38
35. Ergot (*Claviceps purpurea*) of Kentucky bluegrass 38

B. P. I.—176.

THE SEEDS OF THE BLUEGRASSES.

I. THE GERMINATION, GROWING, HANDLING, AND ADULTERATION OF BLUEGRASS SEEDS.

By Edgar Brown,

Botanist in Charge of Seed Laboratory.

DESCRIPTION OF COMMERCIAL AND HAND-GATHERED SEEDS.

Great difficulty is experienced in distinguishing the seeds of the species of Poa. It is especially important to be able to recognize them, as the species vary greatly in value and the seed of one species is frequently substituted for that of another.

The descriptions of the seeds of Poa already published have been largely those of complete or hand-gathered specimens. But the seeds of some kinds as they appear on the market are more or less broken and have lost many of their distinguishing characters. The process of cleaning often rubs off the web at the base of the seed and the hairs along the sides and breaks the tip. On this account descriptions based on specimens of perfect seeds are not to be relied upon in identifying certain commercial Poas.

The mutilation of seeds during the process of cleaning is especially marked in home-grown seed of Kentucky bluegrass (*Poa pratensis*). Even the hand-gathered seed of rough-stalked meadow grass (*Poa trivialis*) is frequently so much injured about the slender apex as to increase greatly the difficulty of distinguishing it from that of Kentucky bluegrass. On the other hand, the commercial seeds of wood meadow grass (*Poa nemoralis*) and fowl meadow grass (*Poa triflora*) retain much of the pubescence on the glume, often the web, and are usually not broken on the tip.

It is important that descriptions and illustrations to be used in practical seed testing be taken from the commercial as well as hand-gathered seed and be comparative in character. Those given in this paper have been prepared from both hand-gathered and commercial seed. The term seed is here used in its popular sense.

GRADES AND QUALITY OF COMMERCIAL SEEDS.

The seeds of all species except Kentucky bluegrass are known to the American trade in only one grade. This is the so-called "fancy" grade, which is based on relative cleanness and on the bright appearance of the seed. The quality of different samples passing under this grade name is not necessarily uniform, but among the more careful dealers a purity standard of from 80 to 90 per cent is usually maintained.

The seeds of Kentucky bluegrass and of Canada bluegrass raised in this country are usually much cleaner and freer from foreign seeds than the European-grown seeds of rough-stalked meadow grass, wood meadow grass, and fowl meadow grass.

Kentucky bluegrass seed is commonly offered in two grades—"fancy," and "extra-clean" or "extra-cleaned." The latter names are a survival of the time when the seed was hand cleaned and the "extra-clean" was the best seed on the market. With the advent of improved machinery the "fancy" grade was established and it is now the only grade generally accepted by the intelligent purchaser. The "extra-clean" still on the market belies its name, since it consists of the chaff or cleanings from the fancy seed, and consequently contains only light seed. Samples of "extra-cleaned" as offered usually contain less than 10 per cent of seed.

In some cases the growers find a sale for the rough or uncleaned seed after it has been passed through a feed cutter. In this condition it has very much the appearance of fine-cut straw with a large percentage of chaff, and can be scattered over pastures and other areas, seeding them as effectually as could be done by the use of fancy recleaned seed. If well cured, the germinating quality of such seed is excellent, and the mass contains from 60 to 70 per cent of pure seed. Except for foreign trade the percentage of germination has little to do with the price and grade of bluegrass seed.

Aside from adulterated samples the purity of "fancy" seed of all species of bluegrass is usually good. Of the 2,887 samples of Kentucky bluegrass tested by the Zurich Seed Control Station from 1876 to 1903 the average purity was 86.3 per cent. Of the 69 samples tested in the Seed Laboratory of the Department of Agriculture during the past year the average purity was 75.02 per cent.

ADULTERATION.

The seed of Canada bluegrass (*Poa compressa*) is the only kind used as an adulterant of Kentucky bluegrass in this country. During the year 1904 649,451 pounds of Canada bluegrass seed were imported from Canada, practically none of which is being sold under its true name. Among the samples of seed sold for Kentucky bluegrass and sent to the Seed Laboratory for examination a large number have

contained from 30 to 50 per cent of Canada bluegrass seed and several have been entirely composed of the Canada seed.

It is significant in this connection that the price of Canada bluegrass seed varies with that of Kentucky bluegrass seed, being usually about one-half that of the latter. This adulteration is not merely a simple fraud by which the farmer pays for what he does not get, but the difference in the resulting pasture or hay crop is very important. Canada bluegrass, while having many good qualities in common with other species of Poa, is by no means a pasture grass, for which purpose Kentucky bluegrass is unexcelled.

The seed of wood meadow grass (*Poa nemoralis*) is sometimes adulterated with other species of Poa, and samples have been offered under this name that contain no wood meadow grass seed. One sample tested in the Seed Laboratory contained 59.4 per cent of *Poa pratensis* and 23 per cent of *Poa compressa*, the remainder being chaff and dirt. Samples of fowl meadow grass (*Poa triflora*) have been examined which consisted largely of various common grass and clover seeds combined with an abundance of weed seeds. These samples contained small quantities of Kentucky and Canada bluegrass seeds, much chaff and dirt, and some of them no seeds of fowl meadow grass.

The seed of Kentucky bluegrass is used to adulterate that of the higher priced *Poa trivialis*, pure seed of the latter species usually being hard to obtain. Some of the German authorities say that it is necessary for every farmer to save his own seed of this grass in order to be sure that it is pure. Hunter[a] says:

> Previously to 1883 good and genuine seed of this species (*Poa trivialis*) could not be obtained in this country [England]. Seed of the *Poa pratensis* was commonly supplied for it. It is now less difficult to procure genuine seed, but large quantities of seed of *Poa pratensis* (which usually costs about one-third the price) are prepared to resemble and are sold for *Poa trivialis*, and it is only by careful microscopic examination that the nature of the seed can be determined

WEIGHT PER BUSHEL.

The standard weight of a bushel of bluegrass seed of any grade is 14 pounds. The actual weight, however, varies from 6 to 8 pounds in the case of "extra cleaned" to 27 pounds or more for especially good samples of fancy recleaned seed. In the bluegrass region of Kentucky it is the usual practice to sell the seed fresh from the strippers or cured in the chaff by the bushel of 14 pounds, but it is always weighed, not measured. The cleaned seed is always sold by the pound. As the weight per bushel of bluegrass seed depends directly on its purity, it is customary in quoting the price of "fancy" seed to accompany it with a statement as to the weight per bushel.

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[a] Treatise on Permanent Pasture Grasses, James Hunter. Chester, England, 1901.

The foreign trade is much more critical than the domestic trade, and the seed exported usually weighs from 22 to 24 pounds per bushel, while the domestic trade is content with seed weighing from 18 to 20 pounds. The heavier seed costs more per pound than the lighter seed, since there is more labor in its preparation, but it is cheaper for the purchaser.

GERMINATION.

The germination of commercial bluegrass seed is often poor. At the Zurich Seed Control Station the average percentage from 3,069 samples of Kentucky bluegrass seed tested from 1876 to 1904 was 65 per cent, while 908 samples of *Poa trivialis* tested showed an average of 72 per cent. The quality of Kentucky bluegrass seed as respects germination appears, however, to be improving. Last year's tests at the Zurich station gave an average of 68 per cent, while a few years ago 50 per cent was considered fair or satisfactory. Only the best seed goes to Europe, and consequently the percentage of germination of that offered in this country is low. As carefully cured seed will germinate from 80 to 90 per cent, the cause for the poor quality of commercial seed is doubtless to be found in the way it is harvested and cured.[a] The usual process is to pile the freshly stripped seed in ricks, either outdoors or in barns. This mass heats quickly if not stirred often during the first few days. One pile left without stirring reached a temperature of 140° F. in sixteen hours, killing all the seed.

GROWING AND HANDLING.

With the exception of our native western species, more or less seed of all the commercial Poas is gathered in Europe, where they are found wild. The harvesting is done by hand from the natural meadows, woods, or other uncultivated areas. The seed is cleaned by hand and carried to market in small quantities and collected by dealers who supply the trade. The United States furnishes Europe with Kentucky bluegrass seed, and Europe furnishes the seed of rough-stalked meadow grass and wood meadow grass, as well as of the other commercial species of Poa used in this country.

Poa pratensis (Kentucky bluegrass).—The bulk of the Kentucky bluegrass seed comes from a limited area known as the bluegrass region of Kentucky. The counties of Bourbon, Scott, Fayette, Clark, and Woodford furnish most of it, although there is a small quantity saved in Shelby County. Some is harvested in southwestern Illinois, and there is another area on the border between Missouri and Iowa where a considerable amount of seed is saved. The seed is gathered from the natural woodland pastures as well as from those where it has

[a] See Bulletin No. 19, Bureau of Plant Industry, "Kentucky Bluegrass Seed: Harvesting, Curing, and Cleaning."

been sown. It is customary to graze cattle on it nearly the entire year, as they do not materially injure the crop of seed if they are kept out for two or three weeks immediately before gathering. The seed is harvested by pulling the heads off with a stripper, the grass not being cut for hay. The cleaning is a rather difficult process, as it is necessary to rub the heads thoroughly in order to separate the seed from the web at the base. The last of the chaff and dirt which is blown out during the cleaning process is sold as "extra-cleaned" seed.

Poa compressa (Canada bluegrass).—The seed of Canada bluegrass is mostly produced in the Province of Ontario, along the north shore of the eastern half of Lake Erie. The soil is a heavy clay on limestone. In this section Canada bluegrass is not sown, but appears as a volunteer in any fields that are not kept under cultivation, making a thick growth and crowding out other grasses and weeds. It is nearly always found in wheat fields when the wheat crop is a partial failure. In this case the seed, ripening as it does at the same time as the wheat, is thrashed with it and screened out in cleaning. Where the seed is harvested alone the grass is cut with a mowing machine and cured the same as ordinary hay, and afterwards thrashed with a clover huller or grain separator. The hay is bright green, even when not cut until after the seed is ripe, and is well liked by some farmers as feed, while it is considered hard and of little value by others. A good crop is from 200 to 300 pounds of clean seed per acre. There has been some demand for this seed in the Southeastern States under the name of Virginia bluegrass. The seed is easily cleaned, as it is comparatively free from wool at the base and does not require rubbing, as does Kentucky bluegrass seed. No special machinery is used except rather long sieves to insure sufficient screening.

Poa trivialis (rough-stalked meadow grass).—The wholesale trade in the seed of rough-stalked meadow grass is largely confined to the city of Hamburg, Germany. The seed is collected in the neighborhood of that city and in the marshes of the Elbe. Seed of good quality is also supplied from Denmark, where in one locality this grass is grown especially for seed, and it is said to yield as much as 400 pounds to the acre. The seed is stripped or the grass is cut and the seed allowed to after-ripen, when it is cleaned by hand.

Poa nemoralis (wood meadow grass).—The seed of wood meadow grass is gathered by hand in the woods of Germany, and cleaned in the same manner as is the seed of *Poa trivialis.*

Poa triflora (fowl meadow grass).—Though widely distributed throughout the northern portion of the United States, this species is chiefly a natural meadow grass of lowlands, and is usually so mixed with sedges and other grasses that seed collection on a commercial scale has not thus far been undertaken in this country. The seed of this species on the market comes from Europe and is very poor.

Prof. L. R. Jones, of the Vermont Agricultural Experiment Station, reports the seed production from a nearly pure stand of this grass as amounting to 6 bushels of 19 pounds each per acre. A small plat yielded seed at the rate of over 7 bushels per acre. The seed is produced abundantly and ripens evenly. In Vermont it is harvested in the latter part of July. The name fowl meadow grass is often applied to another lowland grass, *Panicularia nervata*.

Poa arachnifera (Texas bluegrass).—The seed of Texas bluegrass is gathered by hand in northern Texas. It is cleaned by rubbing between the hands, and, owing to the long, woolly hairs at the base of the seed, it is never "fancy clean." The best seed is produced on rich, black, waxy soil, and is ripe about May 1 to 15. Only a small quantity is gathered each year, and consequently it is high priced and can not be considered as a commercial seed at the present time.

Poa annua (annual bluegrass).—The seed of the annual bluegrass is not on the market in this country, though the plant is common about dwellings, especially in the South and East, and ripens its seed throughout the summer. The seeds do not ripen evenly, the upper ones falling before the lower flowers have opened. The seed is gathered and used to some extent in Europe.

Poa alpina (alpine meadow grass).—Alpine meadow grass is best known in Switzerland, where the seed ripens from the end of June to the middle of July. The viviparous form can be propagated by scattering the buds during the hot weather.

Poa sudetica.—The seed of *Poa sudetica*, which is a European grass, is rare in the market, but is occasionally quoted by French and by German firms. It is sometimes mixed to some extent with the seeds of the meadow grasses, particularly water meadow grass (*Panicularia americana*).

In addition to the foregoing, other species of Poa occur in the western and northwestern United States, where they contribute to the native forage of the stock ranges. The seeds of these species, however, are not found in commerce.

II. DESCRIPTIONS OF THE SEEDS OF THE COMMERCIAL BLUEGRASSES AND THEIR IMPURITIES.

By F. H. Hillman,

Assistant Botanist, Seed Laboratory.

THE BLUEGRASSES.

The "seeds" of the species of Poa, or the bluegrasses, are the ripened florets or individual parts of the smaller clusters, or spikelets, of the general floral system of the plant. The number of florets in each spikelet varies from two to nine in the different kinds of Poa commonly found in commerce. There is some variation in the number of florets in the spikelets of each species. The florets separate readily at maturity, and well-cleaned samples of seed contain few whole or partial spikelets.

A complete, mature spikelet embraces, besides its several florets, a pair of chaffy scales, termed empty glumes, between which the florets, or at least the lower ones, rest. The empty glumes, while somewhat

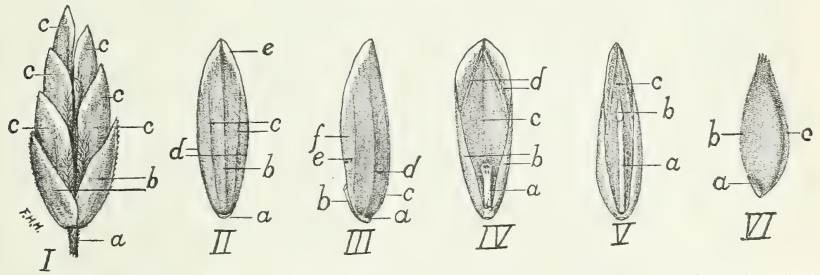

Fig. 1.—I.—A spikelet of Poa: *a*, stem of spikelet; *b*, empty glumes; *c*, florets, or "seeds." II.—Single floret, back view: *a*, callus; *b*, keel; *c*, intermediate veins; *d*, marginal veins; *e*, hyaline portion of glume. III.—Single floret, side view: *a*, callus; *b*, rachilla segment; *c*, keel; *d*, intermediate vein; *e*, marginal vein; *f*, margin of glume. IV.—Single floret, front view: *a*, rachilla segment; *b*, marginal fold; *c*, palea; *d*, keels of palea. V.—Terminal floret, front view: *a*, rachilla segment; *b*, aborted floret; *c*, palea. VI.—Caryopsis, or grain: *a*, location of embryo; *b*, keeled face; *c*, grooved face.

dissimilar, are keeled, acute, and one or three veined. The keel of each is usually hispid-ciliate above the middle. A portion of the stem of the spikelet often remains attached to the base of the empty glumes when these are found in commercial samples.

Each mature, well-developed floret or seed consists of a caryopsis, commonly called grain, two inclosing scales which, together with the empty glumes, constitute the chaff, and a slender appendage, the rachilla segment. (Fig. 1.)

The caryopsis corresponds to an individual grain in wheat, rye, and barley, and consists almost entirely of the seed proper, to which is added only the thin wall of the seed vessel. This is intimately blended with the seed coat, the two forming the covering of the true seed. The caryopsis is spindle-shaped and often broadest between the middle and the base. It is often bluntly keeled along one face and more or less evidently grooved along the opposite face. In the commercial bluegrass seeds the grain is amber-colored or dull wine-colored and semitranslucent. The surface is finely granular and dull. The kernel of the seed forms that part of the grain within the seed and seed-vessel walls. It consists of the embryo and endosperm, the latter forming the greater part. The embryo is situated at the basal extremity of the grain and is evident externally as a small ridge, often within a slight depression, on the keeled face. The grain adheres along its grooved face to the palea in some species in which free grains are not common in well-cleaned commercial seed.

The two chaffy scales of the floret differ chiefly in size, form, relative position, venation, and texture. The larger one, called the flowering glume or simply the glume, incloses the edges of the other, termed palea. The grain rests between the glume and palea, its keeled face lying against the glume. The rachilla segment is at the base of the palea and opposite the glume. It is one of the articulating sections of the rachilla, or axis of the spikelet.

The characters by which the different kinds of bluegrass seeds are distinguished one from another are afforded by the glume, palea, and rachilla segment, and involve size, form, color, veins of the glume, form and texture of the apex of the glume, and the pubescence.

The glume is stiffish and more or less pointed at the ends. Its base is marked by the presence of a small, somewhat knob-like appendage, the callus. The latter bears the scar of attachment of the floret and, in certain species, a more or less pronounced tuft of webby hairs. The back of the glume is more or less keeled along its longitudinal center. Besides the fold forming the keel, the edges of the glume are infolded along the marginal veins. The marginal folds often are most pronounced within and sometimes are confined to the lower half of the glume, in which event the upper margins usually diverge and become spreading or flaring at the apex. The keel is strongly arched lengthwise in some species and in others is nearly straight. Five veins traverse the glume longitudinally; one occupies the keel, two are at the marginal folds and are termed the marginal veins, while the other two are situated midway between the keel and marginal veins and are called intermediate or, by some authors, lateral veins. The intermediate veins exhibit considerable variation in distinctness in the different species. The vein occupying the keel extends to the apex. The apex and often the upper part of the lateral margins of the glume in

most species are thin and translucent, or hyaline. The extent of the hyaline portion of the apex has much to do with the form of the latter and is variable in the different species.

The palea is commonly more delicate in texture than the glume, being partially hyaline. It usually is shorter than the glume, but in some species equals or exceeds it in length. The difference in length usually is most evident in the lower florets of the spikelet. Two veins traverse the palea lengthwise and nearly meet at its apex. The margins of the palea are more or less acutely infolded along these veins, which are called the keels of the palea. The keels are mostly covered by the glume in some species, while in others they are almost wholly exposed. There is some variation in this respect, however, among seeds of the same species. The apex of the palea is often notched.

The rachilla segment is nearly cylindrical and usually somewhat curved. It is slightly expanded at the apex, which is obliquely truncate, its terminal surface constituting the scar of attachment to the succeeding floret. Different florets in the same spikelet in certain species exhibit a marked variation in the length of the rachilla segment, which is shortest in the lower florets and conspicuously longer in the terminal one, where it usually bears an aborted floret as a small, pointed appendage.

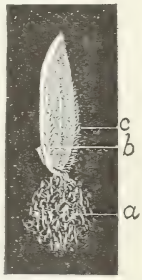

FIG. 2. — Unrubbed Kentucky bluegrass seed (*Poa pratensis*): *a*, web; *b*, pubescence of marginal vein; *c*, pubescence of keel.

The surface of the florets of different species of Poa is subject to considerable variation. Some florets are smooth, or glabrous; others bear numerous minute, stiffish hairs, rendering the surface rough, or scabrous; and some have a fine, appressed pubescence covering a part of the surface. Most of the species have a more or less silky pubescence on the keel and marginal veins below the middle or somewhat higher on the keel. The intermediate veins are more rarely pubescent. The keels of the palea are usually fringed with minute hairs, or are hispid-ciliate, but in some species they are silky pubescent. The basal web is wholly wanting in some species and in others varies from a few fibers to a copious tuft. It readily separates from the floret in most species. The rachilla segment is usually smooth, but in some species it is appressed pubescent. The presence of the hairs on the marginal veins often necessitates that care be used in examining the rachilla segment with respect to pubescence. (Fig. 2.)

The color of mature seeds varies from very light brown to dark brown. Sterile seeds are usually lighter or straw colored. Immature seeds are more or less tinged with green; some are purplish. In certain species the glume is tinged with golden yellow near the apex. The aborted terminal floret and all the hairs are white. The rachilla segment is lighter colored than the glume or palea.

Poorly cleaned samples are apt to contain many sterile florets. These are slender, sometimes shrunken, and usually lighter colored than the grain-bearing florets, which are comparatively plump and often dark colored, owing to the color of the grain appearing through the thin palea. (Fig. 3.)

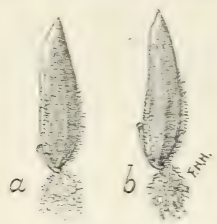

FIG. 3.—Seeds of Kentucky bluegrass (*Poa pratensis*): *a*, grain bearing; *b*, sterile.

The recognition of the several species of Poa, when the identity is questionable, requires the use of a good lens and a knowledge of the principal distinguishing characters. A sample under examination should be spread thinly on a sheet of paper, or, better still, on a black surface. With a good light and means for turning the seeds over while under the lens, they can easily be examined with reference to size, color, distinctness of veins, character of pubescence, the condition of the margins of the glume, etc. Exposing the different sides of the florets to the light while under examination is often absolutely essential in determining the nature of the veins and pubescence.

KEY TO THE SEEDS OF THE MORE COMMON SPECIES OF POA AS FOUND ON HERBARIUM SPECIMENS.

Basal web present.
- Web very persistent and conspicuous ..... *P. arachnifera.*
- Web easily removed, small; keel of the glume pubescent.
  - Intermediate veins distinct.
    - Intermediate veins sharply defined as narrow ridges; glume margins narrow, not easily seen from the side; marginal veins usually smooth. *P. trivialis.*
    - Intermediate veins usually not sharply defined; glume margins broader, easily seen from the side in fertile florets; marginal veins pubescent. *P. pratensis.*
  - Intermediate veins indistinct.
    - Rachilla segment smooth or nearly so; florets 2–2½ mm. long.
      - Florets usually broader above than below the middle; apex usually flaring; rachilla segment smooth ..... *P. compressa.*
      - Florets not evidently broader above than below the middle; apex usually golden yellow; rachilla segment sometimes rough ..... *P. triflora.*
    - Rachilla segment usually pubescent.
      - Florets 2½–3 mm. long, usually not yellow at the apex. ..... *P. nemoralis.*

Basal web not present.
- Florets strongly pubescent.
  - Intermediate veins distinct; palea keels prominent, often arched forward. *P. annua.*
  - Intermediate veins indistinct; palea keels not arched..... *P. alpina.*
- Florets not pubescent..... *P. sudetica.*

KEY TO COMMERCIAL BLUEGRASS SEEDS AFTER PREPARATION FOR MARKET.

Seeds *4–6 mm. long;* web longer than glume, forming a woolly tuft *and causing the seeds to cling in bunches in the sample* ..... *P. arachnifera.*

Seeds 2–2¾ mm. long, usually rubbed free from hairs and disconnected in the sample, *often more or less torn at the apex;* commonest commercial kinds.

Intermediate veins distinct; seeds contracted at the apex *and not wider above than below the middle;* hyaline margin of apex seldom present in rubbed seed. *P. pratensis.*

Intermediate veins very indistinct; seeds broader above than below the middle; hyaline margin of apex usually evident *and flaring* ..... *P. compressa.*

Seeds 2–3 mm. long, chiefly unrubbed; disconnected or clinging somewhat in the sample; usually not torn at the apex; smooth or the pubescence on the veins and the web more or less evident.

Intermediate veins indistinct.

Rachilla segment usually pubescent; long, sterile rachilla segments conspicuously common; *intermediate veins scarcely evident;* keel and marginal veins pubescent; apex of seed often flaring; seed 2½–3 mm. long ..... *P. nemoralis.*

Rachilla segment smooth; intermediate veins but slightly evident; keel and marginal veins pubescent; apex of seed sometimes flaring; *seed 2–2½ mm. long.* *P. triflora.*

Intermediate veins very distinct.

Rachilla segment smooth and slender; keel pubescent, marginal veins usually smooth; apex of seed acute and compressed; *seeds often distinctly curved as viewed from the side* ..... *P. trivialis.*

COMPARISON OF THE PRINCIPAL DISTINGUISHING CHARACTERS OF BLUEGRASS SEEDS.

Species.	Florets.				Glume.				Palea.	Rachilla segment.	Aborted floret.
	Number in the spikelet.	Length.	General form.	Apex.	Intermediate veins.	Silky pubescence.	Basal web.	Color.			
		mm.									
P. pratensis.	3–5	2–2⅜	Lanceolate or ovate-lanceolate.	Acute, mostly torn in commercial seed.	Distinct; not sharply defined, slender ridges; smooth.	On keel and marginal veins; absent in commercial seed.	Well developed; absent in commercial seed.	From light brown to dark brown, often purplish.	Equal to or somewhat shorter than the glume; keels hispid-ciliate and more or less exposed.	⅛ to ⅓ the length of glume; smooth.	Minute.
P. compressa.	3–9	2–2⅛	Oblong-obovate or lanceolate.	Usually obtuse; torn or flaring in commercial seed.	Indistinct or apparently wanting; smooth.	Same as in *P. pratensis.*	Slight; absent in commercial seed.	Straw-colored or light brown, sometimes purplish.	Same as in *P. pratensis.*	⅛ to ⅓ the length of glume; smooth.	Minute.
P. trivialis.	2 or 3	2–2⅛	Narrowly lanceolate, often curved.	Acute; usually hyaline-edged and entire; distinctly keeled.	Sharply defined as slender ridges; smooth.	On keel; marginal veins smooth; often present in commercial seed.	Slight; usually absent in commercial seed.	Light brown, sometimes purplish.	Same as in *P. pratensis.*	Very slender, ⅛ to ⅜ the length of glume; smooth.	Minute.
P. nemoralis.	2 or 3	2⅛–3	Lanceolate or ovate-lanceolate.	Obtuse or acute; hyaline and often flaring.	Indistinct; smooth.	On keel and marginal veins; present in commercial seed.	Same as in *P. trivialis.*	Light brown, sometimes yellowish at the apex.	Same as in *P. pratensis.*	Slender, ¼ to ¾ the length of glume; pubescent; long, sterile segments abundant.	Often as long as the rachilla segment.
P. triflora.	2–4	2–2⅛	Same as in *P. nemoralis.*	Acute or slightly flaring; hyaline.	Same as in *P. nemoralis.*	Same as in *P. nemoralis.*	Same as in *P. trivialis.*	Light brown, usually yellowish at the apex.	Same as in *P. pratensis.*	Slender, ¼ to ⅓ the length of glume; smooth or rough.	Often long.

P. arachnifera.	4 or 5	4–6	Narrowly lanceolate.	Acuminate; hyaline-edged; not flaring.	Usually distinct as narrow ridges; smooth.	Same as in *P. nemoralis.*	Very copious; persistent; present in commercial seed.	Straw-colored or light brown.	Shorter than glume; keels hispid-ciliate.	$\frac{1}{3}$ to $\frac{1}{2}$ the length of glume; smooth.	Minute.
P. annua.	3–5	$1\frac{1}{2}$–3	Robust; ovate-lanceolate.	Acute or broadly flaring and hyaline.	Distinct; more or less pubescent.	On all the veins or only on keel and marginal veins; often on surface between the veins at base.	None.	From light brown to dark brown.	Equal to or shorter than glume; keels prominent, arched, pubescent.	Stout, $\frac{1}{4}$ to $\frac{1}{3}$ the length of glume.	Minute.
P. alpina.	3–6	$2\frac{1}{2}$–$3\frac{1}{2}$	Obovate or ovate-lanceolate.	Acute or flaring, hyaline.	Indistinct or evident below the middle; smooth or pubescent.	On keel and marginal veins and on surface between the veins at base.	None.	Light brown, sometimes purplish and yellowish.	Equal to or shorter than glume; keels exposed, slightly pubescent and hispid-ciliate.	From minute to $\frac{1}{2}$ the length of floret; smooth.	Minute.
P. sudetica.	2 or 3	3–4	Lanceolate or ovate-lanceolate.	Acute or acuminate; keeled and merely hyaline-edged.	Distinct for nearly or quite their full length; scabrous.	None; veins and often the general surface scabrous.	None.	Light brown to dark brown, sometimes purplish.	Equal to or exceeding the glume, often separated from it at the apex.	$\frac{1}{5}$ to $\frac{1}{2}$ the length of floret; the sterile segment tapering.	Minute or sometimes conspicuous.

DESCRIPTIONS OF SPECIES.

Poa pratensis L.

KENTUCKY BLUEGRASS, JUNE GRASS.

Spikelets 3–5 flowered: florets 2–2¾ mm., rarely 3 mm., long, lanceolate or fusiform as viewed from the back, lanceolate or ovate-lanceolate as viewed from the side, mostly acute or the terminal floret sometimes acuminate at the apex, glabrous between the veins, varying from light brown to dark brown, sometimes tinged with purple, sterile florets lighter; glume usually sharply keeled quite to the apex and often strongly arched, particularly at the base: its marginal folds comparatively broad, extending from the base nearly or quite to the apex, becoming hyaline-edged above the middle in the lower florets, usually not expanded or flaring at the apex, the edges nearly meeting in sterile florets, separated and usually distended forward in fertile lower florets, often scarcely covering the palea keels of fertile terminal florets, the hyaline edge more or less torn away and the margins jagged at the apex in rubbed commercial seed; intermediate veins distinct and glabrous; keel and marginal veins silky pubescent below the middle or somewhat higher on the keel: basal web well developed; pubescence and web wanting, except occasional traces of the former, in well-rubbed commercial seed: palea nearly or quite as long as the glume, its keels finely hispid-ciliate and usually covered for the greater part of their length by the margins of the glume: rachilla segment slender, glabrous, varying from about one-sixth of the length of the glume in the lower florets to one-half its length in the terminal one; aborted floret of the sterile rachilla segment minute; grain 1½ mm. long, somewhat keeled and grooved, often broadest below the middle, reddish brown or darker about the embryo, and semitranslucent. (Fig. 4.)

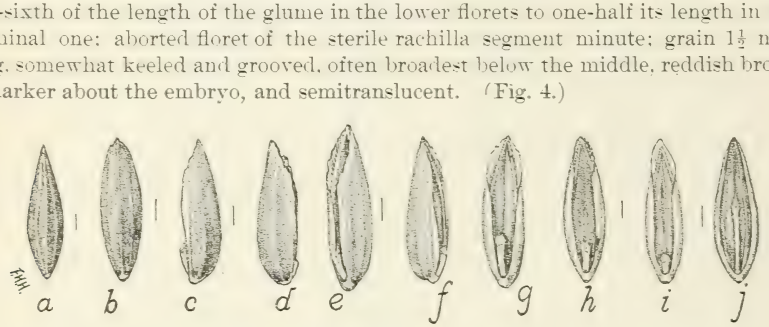

FIG. 4.—Different forms of commercial seeds of Kentucky bluegrass (*Poa pratensis*): *a* and *b*, back views; *c–f*, side views; *g–j*, front views; *j*, a terminal floret.

Commercial Kentucky bluegrass seed is mostly free from the silky and webby hairs present in hand-gathered samples, owing to the rubbing process to which it is subjected before being marketed. The severe rubbing results in more or less injury to the thin margins of the glume, particularly at the apex, which is usually found to be more or less torn when examined with a lens. Seeds of a well-rubbed sample do not tend to cling in small bunches as do those which are unrubbed or hand-gathered. Well-developed seeds are rather robust and have the glume margins well separated and evidently distended forward. Sterile seeds, or such as have the grain wanting or poorly developed, are generally lighter colored, slenderer, and more compressed, while the glume margins more nearly meet and are but slightly or scarcely distended. Such are much lighter in weight than well-developed seeds and consequently are mostly blown out with other chaff in well-cleaned seed.

Kentucky bluegrass seed is most readily confounded with that of Canada bluegrass (*Poa compressa*) and rough-stalked meadow grass (*Poa trivialis*). Owing to the difference in cost, *Poa compressa* is sometimes mixed with or substituted for Kentucky bluegrass, while the latter is sometimes similarly employed with respect to *Poa trivialis*.

The characteristic differences between Kentucky bluegrass seed and that of Canada bluegrass, as exhibited by the bulk samples and by individual seeds under the lens, may be compared as follows:

KENTUCKY BLUEGRASS (*Poa pratensis*).	CANADA BLUEGRASS (*Poa compressa*).
The usual, well-cleaned bulk samples are brown in color.	Average samples lighter colored than those of Kentucky bluegrass.
Individual, well-matured seeds exhibit the same brown color of the bulk sample.	The lighter color of individual seeds affords the principal character for the preliminary recognition of these seeds in mixtures.
Nearly all the seeds taper from the center to both ends and are not broader at the apex than at the base.	Most of the seeds are broader at the apex than at the base, often distinctly broader at the apex than at the middle.
The apex of commercial seeds is usually torn, obtusely pointed, keeled, and scarcely hyaline.	Apex of commercial seeds often torn, mostly expanded or flaring, often but slightly keeled.
The intermediate veins are almost invariably distinct.	The intermediate veins are very indistinct or apparently wanting.

A number of the samples of Kentucky bluegrass seed examined contained seed of the Canada bluegrass. As the latter seed found in commerce usually contains the prickles or even the seeds of Canada thistle (*Carduus arvensis*), these are often found in samples of Kentucky bluegrass seed containing the Canada bluegrass seed. Their presence indicates the admixture, since the Canada thistle does not grow in the seed-producing localities of Kentucky, while it is abundant in Canada, where the Canada bluegrass is produced. Samples of pure Kentucky bluegrass seed are apt to contain the prickles of horse nettle (*Solanum carolinense*), sometimes wrongly called bull thistle, a prickly plant common in the bluegrass region of Kentucky. These prickles are similar to those of the Canada thistle, but may be distinguished, as shown hereafter in this paper in describing the impurities of the bluegrass seeds. The fact that Canada bluegrass only begins to flower at the time Kentucky bluegrass is ripe precludes the possibility of the mixture of the two kinds of seed owing to the fact of growth together. Such mixture can occur only after the seed is gathered, through accident or intent.

Poa compressa L.

CANADA BLUEGRASS, FLAT-STEMMED BLUEGRASS.

Spikelets 3–9 flowered; florets 2–2½ mm. long, oblong-obovate or the terminal one lanceolate as viewed from the back, somewhat narrowly oblong as viewed from the side, obtuse or the terminal one acute, smooth between the veins, straw colored or light brown; glume somewhat arched, especially at the base, and strongly keeled at the back, the keel often less pronounced at the apex than at the base; margins infolded from the base for about three-fourths the length of the floret in the lower florets and nearly to the apex in the upper ones, hyaline-edged above the middle, often broadly so at the apex, which is more or less flaring in the lower florets, the thin apex often torn and jagged in commercial seed; intermediate veins very indistinct or not evident, glabrous; keel and marginal veins silky pubescent below the middle; basal web present, slight; palea nearly or quite equaling the glume, finely hispid-ciliate on the keels, which are usually more or less exposed above the middle, sometimes from the base; rachilla segment glabrous, varying from about one-fifth the length of the glume in the lower florets to one-half its length in the terminal one; aborted floret of the sterile rachilla segment minute; grain 1–1½ mm. long, keeled and slightly grooved, semitranslucent. (Fig. 5.)

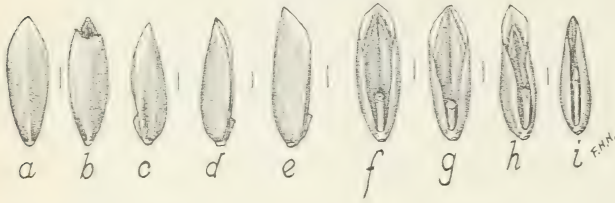

FIG. 5.—Commercial seeds of Canada bluegrass (*Poa compressa*): *a* and *b*, back views; *c–e*, side views; *f–i*, front views of florets; *i*, a terminal floret.

The seed of Canada bluegrass is the cheapest of the bluegrass seeds, and is therefore not adulterated with other Poas, although it is itself used as an adulterant to a considerable extent.

Pure samples of Canada bluegrass seed almost always contain the prickles and sometimes the seeds of Canada thistle (*Cirsium arvensis*); therefore, the occurrence of these prickles with other kinds indicates the use of this species as an adulterant. Their occurrence with seed of *Poa trivialis* without evidence of the presence of Canada bluegrass seed is noted under the discussion of *P. trivialis*.

Poa trivialis L.

ROUGH-STALKED MEADOW GRASS.

Spikelets 2 or 3 flowered; florets 2–2½ mm., rarely 3 mm., long, narrowly lanceolate or the fertile terminal one ovate-lanceolate as viewed from the back, usually lanceolate and curved as viewed from the side, laterally compressed as compared with other species, straw colored or light brown and sometimes purplish, sharply keeled, the keel somewhat arched; margins of the glume scarcely or but slightly distended, narrowly and rather sharply infolded nearly or quite to the apex, which is hyaline-edged, very acute and rarely expanded; intermediate veins very distinct as narrow and sharply defined ridges; keel slightly pubescent below the middle, or rarely smooth; marginal veins smooth or sometimes pubescent, basal web present; palea nearly equal to the glume, its keels smooth or finely hispid-ciliate near the apex and mostly covered by the margins of the glume except in the larger terminal florets; rachilla segment very slender, glabrous, varying from one-fourth to one-half the length of the glume; grain 1–1½ mm. long, keeled and grooved, semitranslucent, reddish brown. (Fig. 6.)

Rough-stalked meadow grass is chiefly hand gathered; consequently the commercial seed is apt to bear more or less of the web as well as the silky pubescence on the keel. In many samples, however, both are rubbed away.

This seed resembles that of *Poa pratensis* and that of *Poa compressa* so closely that both are employed as adulterants, the former apparently to considerable extent, since it has frequently been found to constitute a considerable part of samples of so-called rough-stalked meadow grass. One sample examined marked "*Poa trivialis*" from Europe consisted almost wholly of *Poa compressa*. Several samples from Europe contained prickles of Canada thistle, but no seeds of Canada bluegrass were found.

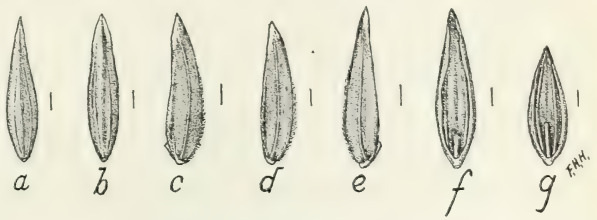

FIG. 6.—Seeds of rough-stalked meadow grass (*Poa trivialis*): *a* and *b*, back views; *c–e*, side views; *f* and *g*, front views; *g*, a terminal floret.

The principal distinguishing characters of the three species may be compared as follows:

ROUGH-STALKED MEADOW GRASS (*Poa trivialis*).	KENTUCKY BLUEGRASS (*Poa pratensis*).	CANADA BLUEGRASS (*Poa compressa*).
Commercial seeds are usually pubescent on the keel vein, usually smooth on the marginal veins and bear more or less of the webby hairs, consequently cling together in masses.	Commercial seeds rarely pubescent on the veins and the webby hairs wanting; consequently mobile in bulk, not clinging in masses; unrubbed seed pubescent on the marginal and keel veins.	
As viewed from the side, the seeds are somewhat curved, much narrower than the others, the glume margins usually only slightly evident.	Seeds mostly straight as viewed from the side, glume margins often strongly distended.	Seeds straight, the glume margins somewhat evident from the side.
Apex of the glume usually uninjured, strongly keeled, acute, slightly hyaline-margined, often curved.	Apex of the glume more or less torn in commercial seed; keeled, sharply pointed, hyaline-edged and not curved in unrubbed seed.	Apex of the glume often torn, otherwise somewhat keeled, obtusely pointed, broader than the base, hyaline-edged.
Intermediate veins sharply defined as narrow ridges.	Intermediate veins distinct as rather coarse ridges.	Intermediate veins indistinct or apparently wanting.
Rachilla segment very slender and less variable in length than in *P. pratensis* or *P. compressa*.	Rachilla segment coarser than in *P. trivialis* and often very short.	

Poa nemoralis L.

WOOD MEADOW GRASS.

Spikelets 2 or 3 flowered; florets 2½–3 mm. long, lanceolate or ovate-lanceolate, mostly acute at the apex, light brown, sometimes yellowish tinged near the apex; glume rather broadly keeled and somewhat arched at the back; margins of the glume narrowly infolded quite to the apex or hyaline-edged and often flaring above the middle; intermediate veins very indistinct; keel and marginal veins silky pubescent below the middle; basal web slight; surface between the veins glabrous; palea nearly equal to the glume, evidently shorter in florets having a flaring apex, its keels hispid-ciliate and usually covered by the margins of the glume; rachilla segment varying from one-fourth to three-fourths of the length of the glume, the sterile rachilla segment very uniformly much longer than the others, more or less appressed pubescent, the pubescence somewhat variable and sometimes nearly wanting; aborted floret of the sterile rachilla segment often one-half as long as the segment; grain 1½ mm. long, rather slender, semitranslucent. (Fig. 7.)

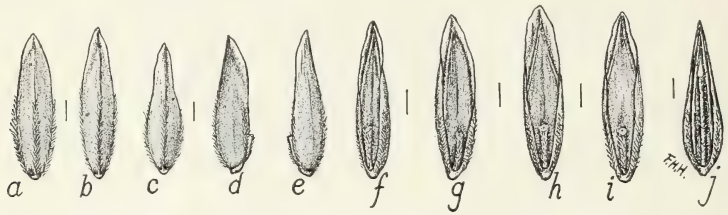

FIG. 7.—Seeds of wood meadow grass (*Poa nemoralis*): *a–c*, back views; *d* and *e*, side views; *f–j*, front views; *j*, a terminal floret.

Commercial wood meadow grass seed is not rubbed in preparation for market, and therefore possesses much of its rather persistent and prominent silky pubescence, and the thin tips of the florets are mostly uninjured. The pubescence of the rachilla segment is persistent and present in most of the seeds of all pure samples of this species. It affords the most marked characteristic by which the seeds of *P. nemoralis* may be distinguished from those of other commercial species of Poa. The conspicuously longer rachilla segments of the terminal florets are noticeably abundant in samples of this species, since these florets constitute from one-third to one-half of all the seed. The abundance of the long rachilla segments is helpful in distinguishing these seeds from those of other Poas.

Commercial seed of *P. nemoralis* is apt to be very much adulterated with other species of Poa. Of a number of samples examined less than half were true to name. One was nearly pure Canada bluegrass seed, and the rest consisted in part of one or all of the following species: *P. pratensis*, *P. compressa*, and *P. trivialis*.

The following comparison of characters should render it comparatively easy to distinguish the seeds of *P. nemoralis* from those of the other species.

Wood meadow grass (*Poa nemoralis*).	Kentucky bluegrass (*Poa pratensis*); Rough-stalked meadow grass (*Poa trivialis*).	Canada bluegrass (*Poa compressa*).
Silky pubescence of the veins mostly present and prominent.	Silky pubescence of the veins wanting or but slight.	
Apex of the glume slenderly pointed or narrowly flaring.	Apex of the glume acute.	Apex of the glume broadly flaring.
Intermediate veins indistinct.	Intermediate veins distinct.	Intermediate veins indistinct.
Rachilla segment pubescent, often more than half the length of the glume.	Rachilla segment smooth, not exceeding half the length of the glume.	

Poa triflora Ehrh. (**P. flava** L., **P. serotina** Ehrh.).

FOWL MEADOW GRASS, FALSE REDTOP.

Spikelets 2–4 flowered; florets 2–2½ mm. long, lanceolate or ovate-lanceolate as viewed from the back, broadly keeled and strongly arched at the back, light brown and usually strongly tinged with yellow above the middle, sometimes purplish, margins of the glume narrowly infolded below the middle or quite to the apex, which is hyaline-edged, expanded but scarcely flaring; intermediate veins indistinct; keel and marginal veins silky pubescent below the middle; basal web slight; palea nearly or quite equal to the glume, finely hispid-ciliate on the keels, which are mainly covered by the glume margins in the lower florets; rachilla segment slender, glabrous or sometimes slightly scabrous, from one-fourth to one-half or two-thirds the length of the glume; aborted floret of the sterile rachilla segment often prominent and nearly as long as the rachilla segment; grain 1 mm. long, comparatively robust and smooth, scarcely keeled or grooved, semitranslucent. (Fig. 8.)

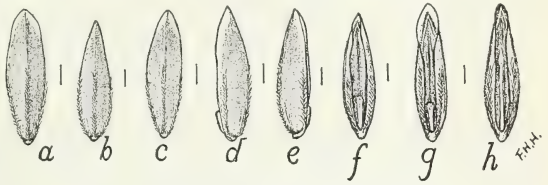

Fig. 8.—Seeds of fowl meadow grass (*Poa triflora*): *a–c*, back views; *d* and *e*, side views; *f–h*, front views; *h*, a terminal floret.

Most, if not all, of the seed of *P. triflora* on the market appears to be of foreign production. The samples examined have proved to be the worst found among the bluegrasses. It is probable that a better grade of seed could be secured from the natural meadows in this country where this species often constitutes the principal grass. The seeds of *P. triflora* are very similar to those of Canada bluegrass and wood meadow grass.

The principal distinguishing characters of the three kinds are as follows:

Fowl meadow grass (*Poa triflora*).	Canada bluegrass (*Poa compressa*).	Wood meadow grass (*Poa nemoralis*).
Seeds 2–2½ mm. long.	Seeds 2–2½ mm. long.	Seeds 2½–3 mm. long.
Seeds mostly narrower at the apex than at the center.	Seeds mostly broader at the apex than at the center or base.	Seeds narrower or not broader at the apex than at the center.
Seeds usually yellowish at the apex.	Seeds not yellowish at the apex.	Seeds sometimes yellowish at the apex.
Intermediate veins usually evident but indistinct.	Intermediate veins indistinct or more commonly not evident.	Intermediate veins indistinct.
Pubescence of the veins and the web often present in commercial seed.	Pubescence of the veins and the web mostly absent in commercial seed.	Pubescence of the veins usually present in commercial seed.
Rachilla segment mostly smooth, sometimes slightly rough, often two-thirds the length of the glume.	Rachilla segment smooth, not exceeding one-half of the length of the glume.	Rachilla segment pubescent or sometimes only rough, often three-fourths the length of the glume.

The name fowl meadow grass is often applied, both by seedsmen and by writers upon grasses, to *Panicularia nervata*.

Poa arachnifera Torr.

TEXAS BLUEGRASS.

Spikelets 4 or 5 flowered; florets 4–6 mm. long, narrowly lanceolate, acuminate, straw colored or light brown; glume strongly keeled quite to the apex and somewhat arched; margins narrowly infolded below and becoming broadly hyaline above the middle, not widely flaring at the apex; marginal and keel veins strongly pubes-

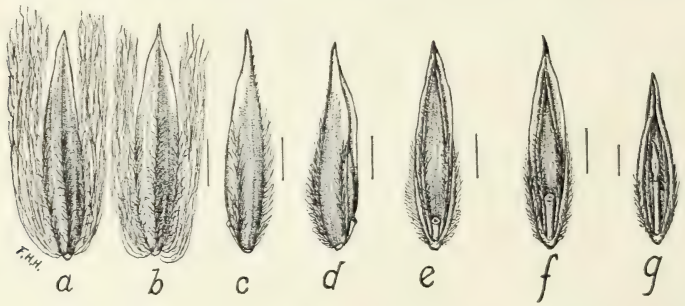

FIG. 9.—Seeds of Texas bluegrass (*Poa arachnifera*): *a* and *b*, back views, seeds showing the long hairs of the web; *c* and *d*, side views; *e–g*, front views; *g*, a terminal floret.

cent with long, silky hairs; basal web copious, often twice as long as the floret, very persistent; surface between the veins glabrous, the keel hispid-ciliate above the middle; palea from three-fourths to four-fifths the length of the glume, its keels more or less exposed, silky pubescent to the middle and hispid-ciliate at the apex; rachilla segment varying from about one-sixth to one-third the length of the glume, glabrous; aborted floret of the sterile rachilla segment minute; grain slender, 1½–3 mm. long, oblong-fusiform, nearly opaque, distinctly grooved and keeled. (Fig. 9.)

Texas bluegrass seed in commerce is unrubbed, and as the silky pubescence and web are very persistent they are always present. The hairs are so long and copious that the seeds cling in loosely matted, woolly bunches, and thus are easily distinguished from all the other commercial Poas. (Fig. 10.)

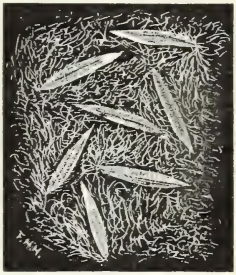

FIG. 10.—A cluster of Texas bluegrass seeds matted by the webby fibers.

Poa annua L.

ANNUAL MEADOW GRASS.

Spikelets 3–5 flowered; florets 1½–3 mm. long, ovate or ovate-lanceolate and relatively robust, strongly keeled and arched at the back, more or less densely pubescent, light brown or dark brown and often purplish or yellowish; margins of the glume very narrowly infolded below the middle, thin and broadly hyaline above the middle in the lower florets, flaring, gaping, or infolded at the apex; intermediate veins usually distinct as narrow ridges extending from the base to the margin of the apex, glabrous or pubescent; marginal veins and keel densely soft-pubescent below the middle; surface between the veins sometimes more or less pubescent at the base; web wanting; palea somewhat shorter than the glume, except in the terminal floret; keels of the palea coarse and prominent, mostly exposed, usually arched forward and exposed to side view in florets having a well-developed grain, often contracted toward the rachilla segment at the base, silky pubescent from near the base nearly to the apex; rachilla segment glabrous, from one-fourth to one-third the length of the glume, aborted floret of the sterile rachilla segment minute; grain 1–1½ mm. long, robust, distinctly granular, keeled and grooved, slightly translucent. (Fig. 11.)

The seed of *Poa annua* is not in the trade and is not apt to become mixed with the commercial bluegrass seeds. It may be readily distinguished from the common commercial species of Poa by its abundant

FIG. 11.—Seeds of annual meadow grass (*Poa annua*): *a* and *b*, back views; *c–e*, side views; *f–i*, front views; *i*, a terminal floret.

pubescence, arched and silky pubescent keels of the palea, and robust form. The seed most closely resembles that of *Poa alpina*, from which it is distinguished in individual seeds by its distinct intermediate veins and prominent, arched, and silky pubescent but not hispid-ciliate palea keels.

Poa alpina L.

ALPINE MEADOW GRASS.

Spikelets 3–6 flowered; florets 2½–3½ mm. long, ovate-lanceolate or obovate, the uppermost lanceolate, broadly keeled, arched, acute, or obtuse, light brown, sometimes purplish, and often yellowish tinged at the apex; margins narrowly infolded below the middle and becoming broadly hyaline at the apex; intermediate veins

indistinct or evident only below the middle; keel and marginal veins silky pubescent below the middle or higher on the keel, which is hispid at the apex; surface between the marginal veins and keel appressed pubescent at the base; web wanting; palea nearly or quite equal to the glume, its keels not arched as in *Poa annua*, slightly silky pubescent below the middle and hispid-ciliate above; rachilla segment glabrous, varying from no longer than wide to one-third the length of the glume; aborted floret of the sterile rachilla segment minute; grain 1½ mm. long, keeled and grooved, semitranslucent, dark reddish brown, granular. (Fig. 12.)

FIG. 12.—Seeds of alpine meadow grass (*Poa alpina*): *a* and *b*, back views; *c–e*, side views; *f–h*, front views; *h*, a terminal floret.

The seed of *Poa alpina* is not on the market and is not likely to be found in commercial seeds. Individual seeds of *P. alpina* closely resemble those of *P. annua*, but are to be distinguished by the indistinct intermediate veins of the glume, the variable rachilla segment, and especially by the keels of the palea, which are slenderer, not arched, less pubescent, and strictly hispid-ciliate above. The plant is alpine and occurs in the northern part of the United States as far west as Colorado, in Canada and Alaska, and in Europe and Asia.

Poa sudetica Haenke.

Spikelets 2 or 3 flowered; florets 3–4 mm. long, lanceolate or ovate-lanceolate; apex acute or acuminate; glume somewhat arched and strongly keeled at the back, light brown or dark brown, sometimes tinged with purple; margins of the glume narrowly infolded below the middle, narrowly hyaline-edged above the middle and not flaring at the apex; all the veins distinct, never silky pubescent, usually hispid;

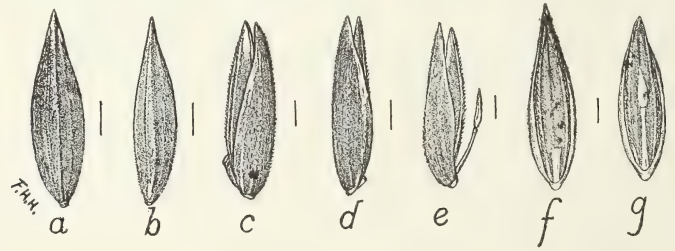

FIG. 13.—Seeds of *Poa sudetica: a* and *b*, back views; *c–e*, side views; *f* and *g*, front views; *g*, a terminal floret.

general surface scabrous or sometimes glabrous; web not present; palea equaling or somewhat exceeding the glume and often separated from it at the apex in florets having a well-developed grain; keels of the palea hispid-ciliate, mostly exposed and more or less evident from the side; rachilla segment varying from one-fifth to one-third or even one-half the length of the glume, glabrous or scabrous, sterile rachilla

segment tapering to the apex, the aborted floret usually minute, but sometimes conspicuous and nearly equal to the rachilla segment; grain about 2 mm. long, robust, light brown, slightly keeled and grooved, semitranslucent. (Fig. 13.)

This is a European species not found in the American market.

Panicularia spp.

Owing to the fact that *Panicularia nervata* is sometimes sold as fowl meadow grass, a description of its seed is presented. A description of the closely allied *P. americana*, which is often associated with *P. nervata*, is added as an aid in comparing the two species.

Panicularia nervata (Willd.) Kuntze.

NERVED MANNA GRASS, SOMETIMES CALLED FOWL MEADOW GRASS.

Florets 1–1½ mm. long, robust, ovate (obovate with reference to the plant), light brown, purplish and sometimes greenish when immature; glume rounded at the back, prominently seven-veined, its margins somewhat infolded at the base and not flaring at the apex, which is sometimes narrowly hyaline; surface smooth, except the veins, which are sometimes scabrous; palea equal to or sometimes longer than the glume, broad, the keels exposed, prominent and nearly meeting at the rounded and sometimes slightly notched apex, usually scabrous above the middle; rachilla segment one-fifth to one-fourth the length of the glume, subcylindrical and scarcely expanded at the apex, the terminal one somewhat longer than the others and tipped by a minute, aborted floret; grain loosely held by the stiffish glume and palea, obovate, slightly flattened, ¾–1 mm. long, smooth, somewhat polished, very dark brown or black, sometimes slightly translucent. (Fig. 14.)

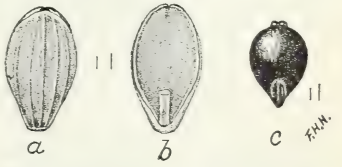

FIG. 14.—Seeds of nerved manna grass (*Panicularia nervata*): *a* and *b*, back and front views; *c*, grain.

Panicularia americana (Torr.) MacM.

REED MEADOW GRASS, WATER MEADOW GRASS, TALL MANNA GRASS.

Florets 3–3½ mm. long, elliptical-oblong as viewed from the front or back, somewhat spindle-shaped as viewed from the side, obtuse at the apex, brown, or purplish before complete maturity; glume rounded at the back, distinctly seven-veined, its margins narrowly infolded at the base and not flaring at the apex; surface smooth between the scabrous veins; palea equal to the glume, concave, its keels exposed, nearly meeting at the apex, very finely hispid-ciliate; rachilla segment one-fifth to one-fourth the length of the glume, subcylindrical, somewhat expanded at the apex, that of the terminal floret slightly longer and tipped by a minute, aborted floret; grain broadly oblong, 1½–2 mm. long, somewhat flattened, very dark brown, slightly translucent, smooth, and somewhat polished when fully developed. (Fig. 15.)

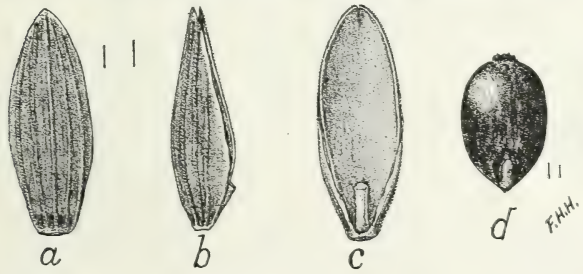

FIG. 15.—Seeds of water meadow grass (*Panicularia americana*): *a*, *b*, and *c*, back, side, and front views of seeds; *d*, grain.

WEED SEEDS COMMONLY FOUND WITH COMMERCIAL BLUEGRASS SEEDS.

The following weed seeds are those most frequently found with the various kinds of bluegrass seed.

Bursa bursa-pastoris (L.) Britton.

SHEPHERD'S-PURSE.

Seeds $\frac{2}{3}$–1 mm. long, oval-oblong, one extremity often pointed by the whitish tissue of the scar, flattened with rounded edges; faces similar and usually presenting two shallow grooves; color yellowish or reddish brown, usually darker near the scar; surface nearly smooth; endosperm absent; embryo curved upon itself, the cotyledons incumbent; seeds developing a coat of transparent mucilage when placed in water. (Fig. 16.)

FIG. 16.—Seeds of shepherd's-purse (*Bursa bursa-pastoris*): *a*, side view; *b*, edge view; *c*, natural size of seeds.

Seldom found abundantly, but occurring frequently in all of the commercial bluegrass seeds.

Lepidium virginicum L.

PEPPERGRASS.

Seeds $1\frac{1}{2}$ mm. long, much flattened, ovate with one edge straight and thicker than the other, the curved edge narrowly margined, the margin usually hyaline and broadest at the broad end of the seed; faces similar, each nearly crossed lengthwise by a curved groove; scar at the small extremity, marked by a small, whitish tissue; surface smooth, dull, and reddish yellow; endosperm wanting; embryo curved upon itself, the cotyledons accumbent; seeds developing a copious coat of transparent mucilage when placed in water. (Fig. 17.)

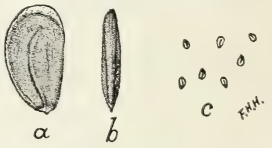

FIG. 17.—Seeds of peppergrass (*Lepidium virginicum*): *a*, side view; *b*, edge view; *c*, natural size of seeds.

Frequently found in home-grown seed and sometimes very abundant, especially in poorly cleaned seed.

Cerastium vulgatum L.

MOUSE-EAR CHICKWEED.

Seeds about $\frac{1}{2}$ mm. long, flattened but not thin, rounded or triangular, the broad edge rounded, the narrow edge notched; surface roughened by small tubercles or very short ridges, dull, and reddish-brown; embryo cylindrical, curved about the endosperm, its extremities nearly meeting at the notch in the seed coat. (Fig. 18.)

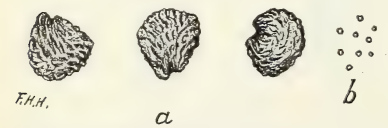

FIG. 18.—Seeds of mouse-ear chickweed (*Cerastium vulgatum*): *a*, side views; *b*, natural size of seeds.

Found frequently; sometimes abundant in poorly cleaned seed.

Alsine media L.

COMMON CHICKWEED.

Seeds circular-ovate, about 1 mm. in diameter with little variation in size, flattened with plane faces and flattened edges; scar in a small notch in the edge; surface dull, slightly tubercled, the tubercles in rows on the edges and in more or less evidently

concentric rows on the similar faces; color brown, or reddish in immature seeds: embryo cylindrical, curved about the endosperm, its extremities nearly meeting at the scar. (Fig. 19, *a*.)

Alsine media is very common in the United States, but is so low-growing that the American method of seed stripping prevents the occurrence of its seeds in abundance in commercial bluegrass seeds. Its seeds are common in European bluegrass seeds, particularly those of rough-stalked meadow grass.

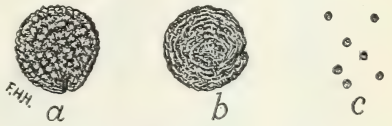

FIG. 19.—Seeds of chickweeds: *a*, *Alsine media*; *b*, *A. graminea*; *c*, natural size of seeds.

Alsine graminea (L.) Britton.

Seeds similar to those of *Alsine media*, except in form and surface markings; usually circular or oval; faces and edges somewhat rounded, finely roughened by short, interlacing ridges which are arranged more or less concentrically on the faces and parallel on the edges; surface dull; color grayish-brown, immature seeds reddish. (Fig. 19, *b*.)

Not found in American seed; frequent, although not abundant, in European seed.

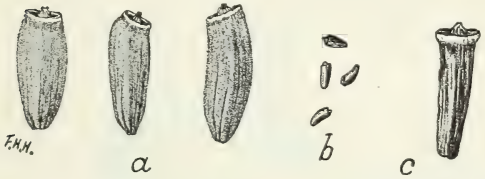

FIG. 20.—Seeds of Canada thistle (*Carduus arvensis*): *a*, well-matured seeds; *b*, natural size of seeds; *c*, a shriveled seed.

Carduus arvensis (L.) Robs.

CANADA THISTLE.

Seeds (akenes) 2–3 mm. long, oblong-lanceolate, flattened with obtuse edges, slightly ridged along each face, straight or curved edgewise, sometimes facewise; apex truncate, often obliquely so, concave with a ring-like border; corolla scar represented by a central, conical projection; surface dull and mostly smooth, sometimes with several narrow, longitudinal grooves; color brown, the apical margin usually lighter and sometimes yellowish. (Fig. 20.)

Prickles of Canada thistle and horse nettle (*Solanum carolinense*) often occur in certain bluegrass seeds. While the presence of the former is significant with respect to adulteration, the two kinds are apt to be confounded.

The prickles of Canada thistle are 2–6 mm. long, very slender, yellowish, usually expanded and laterally flattened at the base, which consists of a portion of the leaf tissue and is darker colored than the rest of the prickle, somewhat rounded or angular in form and jagged-edged. (Fig. 21, *c* and *d*).

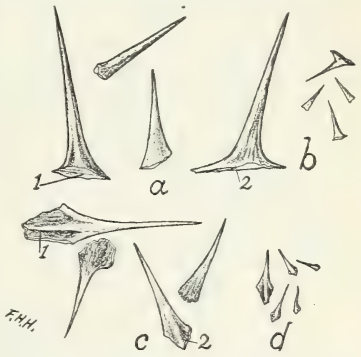

FIG. 21.—Prickles often found with bluegrass seed: *a* and *b*, horse nettle (*Solanum carolinense*) enlarged and natural size; *c* and *d*, Canada thistle (*Carduus arvensis*) enlarged and natural size; 1 and 2, characteristic forms of the bases of the two kinds of prickles.

The prickles of horse nettle (*Solanum carolinense*) are coarser, 4–8 mm. in length, light yellow in color, usually not darker at the base. They are produced on the stems and the coarse midribs of the leaves, and on breaking off have a transversely flattened scar. They occur frequently in samples of Kentucky-grown *Poa pratensis* and are easily mistaken for those of Canada thistle. (Fig. 21, *a* and *b*.)

Matured seeds, shriveled seeds, and prickles from the leaves and stems of Canada thistle are frequently found in Canada bluegrass seed. The presence of the prickles

in the more expensive kinds of bluegrass seed indicates the probable use of Canada bluegrass seed as an adulterant. These prickles have been found, however, in rough-stalked meadow grass seed in which no trace of Canada bluegrass seed appeared. Owing to the troublesome nature of Canada thistle, care should be taken not to introduce its seeds with those of the bluegrasses.

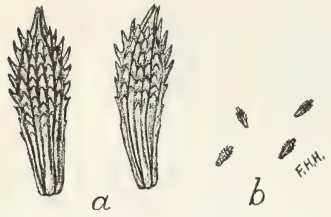

FIG. 22.—Seeds of dandelion (*Taraxacum taraxacum*): *a*, side views; *b*, natural size of seeds.

Taraxacum taraxacum (L.) Karst.

DANDELION.

Seeds (akenes) 3–4 mm. long, including the persistent base of the beak, which forms the pointed apex of the seed, lance-shaped or broadly so, straight or curved, flattened or slightly four-angled with similar faces, barbed in the upper, broader half; teeth directed toward the apex, prominent on the edges and arranged in about five rows on each face, which has two slender grooves with three rows of teeth between them; surface dull; color light brown or dark brown. (Fig. 22.)

Occurring occasionally in both American and European seed, these seeds have appeared most frequently in Kentucky bluegrass and rough-stalked meadow grass seeds.

Matricaria inodora L.

SCENTLESS CAMOMILE.

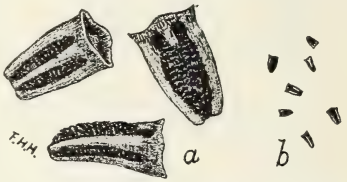

FIG. 23.—Seeds of scentless camomile (*Matricaria inodora*): *a*, back, front, and edge views; *b*, natural size of seeds.

Seeds (akenes) 1½–2 mm. long, slender or robust, oblong with obtuse extremities, tapering somewhat from the truncate apex to the base, slightly flattened; faces dissimilar, one having three prominent, longitudinal ribs joined at the apex, the lateral ribs and a partial one joined to them at the apex appearing on the opposite face, which also presents two small cavities separated by the partial ridge; surface between the ridges transversely roughened, dark brown or black and darker than the brown or yellowish ridges. (Fig. 23.)

Found only in foreign-grown seed, chiefly in rough-stalked meadow grass and wood meadow grass seeds.

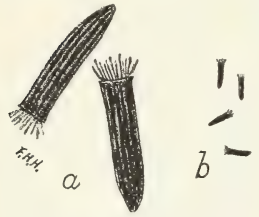

FIG. 24.—Seeds of hawkweed (*Hieracium* sp.): *a*, side views; *b*, natural size of seeds.

Hieracium sp.

HAWKWEED.

Seeds (akenes) 1–3 mm. long, cylindrical, pointed at the base; apex truncate, bearing a small tuft of short, whitish, marginal bristles (the remnants of the pappus bristles); surface lightly ten-ridged lengthwise; color brown or black, reddish in immature seeds. (Fig. 24.)

Found most frequently in wood meadow grass seed. The seeds of several species of hawkweed, occurring in both America and Europe, are practically indistinguishable. Specific determinations can not be made by examination with a lens. The troublesome character of orange hawkweed (*Hieracium aurantiacum*), whose seeds are 1¼–1¾ mm. long, justifies care in the use of seed containing seeds of any species of hawkweed.

Anthemis cotula L.

DOG FENNEL, MAYWEED.

Seeds (akenes) cylindrical, broadly club-shaped, 1½–2 mm. long, straight or curved; surface dull and usually roughened by many small tubercles more or less distinctly arranged in ten rows, indistinctly few-tubercled or nearly smooth, but commonly more or less evidently ten-ribbed; base tipped by the rounded, whitish scar; apex rounded or slightly pointed; color varying from light to dark brown. (Fig. 25.)

Found occasionally, but never abundantly, in both American and European bluegrass seed.

FIG. 25.—Seeds of dog fennel (*Anthemis cotula*): *a*, side views; *b*, natural size of seeds.

Chenopodium album L.

LAMB'S-QUARTERS, PIGWEED.

Seeds nearly circular, lens-shaped, with blunt edges, 1–1⅓ mm. in diameter, occurring in commercial seeds as free seeds or as fruits, the seeds proper being invested by the thin pericarp; free seeds jet black, smooth or nearly so, and highly polished; scar occupying a curved groove extending from the center to the edge of one face and usually evident as a light-colored line; fruits only slightly larger than the seeds, mostly gray or black and dull; pericarp wall often broken away, exposing the shining black surface of the seed; again, this wall and the seed coat are often broken, exposing the yellowish or whitish embryo and endosperm; embryo cylindrical, occupying the border of the seed and surrounding the endosperm, its extremities almost meeting, the tip of the caulicle occupying an extension of the seed coat at the edge beside the scar. (Fig. 26.)

FIG. 26.—Seeds of lamb's-quarters (*Chenopodium album*): *a*, various forms of seeds; *b*, natural size of seeds.

Found chiefly in Kentucky bluegrass and Canada bluegrass seeds, but not frequently and never abundantly.

Plantago lanceolata L.

RIB-GRASS, BUCKHORN, ENGLISH PLANTAIN.

Seeds oval-oblong, 1¾–3 mm. long, flattened, one face convex, the other having a deep groove and rounded, infolded edges which scarcely meet at one end; surface smooth or slightly uneven, shining in fresh seed, brown or somewhat amber-colored; scar situated at the center of the grooved face; embryo straight, in the center of the endosperm, usually evident through the somewhat transparent endosperm and seed coat. When placed in water the seeds develop a coat of transparent mucilage. (Fig. 27.)

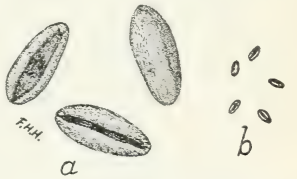

FIG. 27.—Seeds of rib-grass (*Plantago lanceolata*): *a*, front and back views of seeds; *b*, natural size of seeds.

Small seeds are found to some extent in both American and European seed; more commonly in Kentucky bluegrass than in Canada bluegrass seed.

Rumex crispus L.

CURLED DOCK.

Seeds (akenes) 1½–2½ mm. long, triangular with equal faces and broadly ovate-lanceolate; color dark reddish brown; surface smooth, polished; apex acute; base obtuse, contracted, and narrowly truncate at the scar; edges narrowly margined; faces longitudinally concave in poorly developed seeds; true seed coat thin; embryo cylindrical, resting in the center of one face of the endosperm; caulicle pointing to the base of the akene. (Fig. 28.)

FIG. 28.—Seeds of curled dock (*Rumex crispus*): *a*, broad and narrow forms; *b*, natural size of seeds.

Found occasionally, especially in Kentucky bluegrass and in Canada bluegrass seeds; small, imperfectly developed seed more commonly found than large, heavy seed. Their sharply three-angled, beechnut-like form distinguishes them from other impurities, except one or two other kinds of dock. The docks are destructive weeds, and care should be taken to prevent the sowing of their seeds.

Rumex acetosella L.

SHEEP'S SORREL, SORREL.

Seeds (fruits) acutely oval, three-angled, with equal faces, 1–1½ mm. long; represented in commercial seed by the seed-like akene only or by the akene covered by the thin, closely fitting perianth segments, which are six in number, three broad ones covering the sides of the akene and three small ones covering the angles at the base; covered by the perianth, the seeds are finely roughened, dull, and reddish brown; venation of the three broad segments evident; small segments at the basal angles often broken away; akenes but slightly smaller than when covered by the perianth, bluntly three-angled; surface smooth, somewhat polished, reddish brown or wine colored, often semitranslucent; angles dark at the apex; internal structure essentially the same as in *Rumex crispus*. (Fig. 29.)

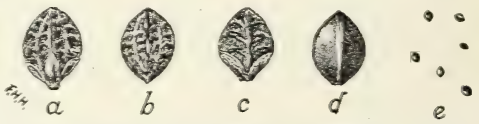

FIG. 29.—Seeds of sorrel (*Rumex acetosella*): *a*, *b*, and *c*, seed enveloped by the perianth; *d*, seed with perianth removed; *e*, natural size of seeds.

One of the commonest impurities in commercial seed, found in all seed of the cultivated bluegrasses.

Veronica arvensis L.

CORN SPEEDWELL.

Seeds ½–¾ mm. long, flattened and thin, more or less regularly oval, plane or sometimes curved face-wise; center of the inner face marked by the relatively large, raised chalaza, which is united by a narrow ridge (the raphe) to the scar on the edge of the smaller extremity of the seed; external face slightly ridged longitudinally, indicating the position of the embryo, which is surrounded by the endosperm; surface dull, finely roughened by somewhat radially-disposed ridges, and reddish yellow. (Fig. 30.)

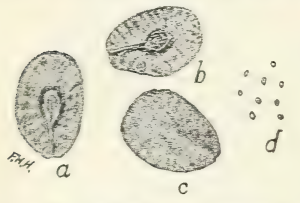

FIG. 30.—Seeds of corn speedwell (*Veronica arvensis*): *a* and *b*, front views, *c*, back view; *d*, natural size of seeds.

Found in bluegrass seed of various species, especially common in seed of Kentucky bluegrass. The relatively prominent chalaza and the radially uneven surface distinguish them from the seed of the closely allied *Veronica peregrina*, which sometimes occurs in commercial seed.

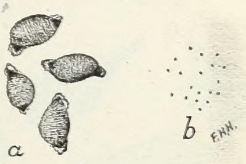

FIG. 31.—Seeds of slender rush (*Juncus tenuis*): *a*, seeds enlarged; *b*, natural size of seeds.

Juncus tenuis Willd.

SLENDER RUSH.

Seeds very minute, about $\frac{1}{3}$ mm. long, broadly spindle-shaped, the extremities usually slightly curved; surface (as seen under a lens) nearly smooth; color reddish yellow, darker at the extremities, which sometimes bear a small white tissue. (Fig. 31.)

Often quite abundant in poorly cleaned Kentucky bluegrass seed, sometimes clinging in bunches of several seeds each.

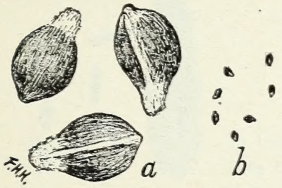

FIG. 32.—Seeds of field rush (*Juncoides campestre*): *a*, different views; *b*, natural size of seeds.

Juncoides campestre (L.) Kuntze.

FIELD RUSH.

Seeds $1\frac{1}{4}$–$1\frac{1}{2}$ mm. long, oval, not flattened, the extremities unequally pointed, the basal extremity turned slightly to one side and consisting of soft white or yellowish tissue; a narrow and often indistinctly defined whitish ridge extends from the base to the apex; body of the seed wine-colored and semitranslucent or grayish. (Fig. 32.)

Found frequently in the seed of wood meadow grass and of the *Poa sudetica* of European origin.

Juncoides albida DC

WOOD RUSH.

Seeds 1–$1\frac{1}{4}$ mm. long, narrowly oval, not flattened; base without an appendage of soft tissue; apex more acutely pointed than the base; a distinct brown or reddish brown ridge joins the base and apex; body of the seed reddish brown or wine-colored, often semitranslucent. (Fig. 33.)

Found in various species of European-grown bluegrass seed. The usually smaller size, absence of the basal appendage, and more distinct and constant reddish-brown lateral ridge serve to distinguish these from the seeds of *Juncoides campestre*.

FIG. 33.—Seeds of wood rush (*Juncoides albida*): *a*, different views; *b*, natural size of seeds.

Carex cephalophora Muhl.

OVAL-HEADED SEDGE.

Seeds (akenes) $1\frac{1}{2}$–2 mm. long, lens-shaped and broadly ovate, contracted at the base and tipped at the apex by a conical appendage (the base of the style); surface smooth and dull; color varying from light to dark brown; apical appendage often broken away in seeds found in commercial samples; perigynium broadly ovate-lanceolate, plano-convex, the tapering extremity usually rough-edged and notched at

the apex; surface sometimes slightly grooved or ridged lengthwise, otherwise smooth; color varying from light brown to greenish or dark brown. (Fig. 34.)

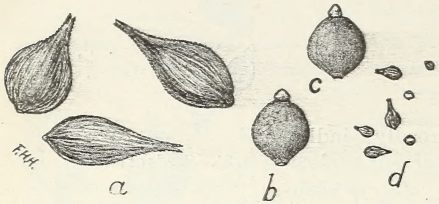

FIG. 34.—Seeds of sedge (*Carex cephalophora*): *a*, seeds inclosed by the perigynium; *b* and *c*, seeds with perigynium removed; *d*, natural size of seeds.

Seeds of sedge (Carex) are found in both American and European bluegrass seed. Owing to the wide area of their production, the seeds of various species of Carex occur in commercial bluegrass seed. The seeds of Carex are fruits (akenes) and occur free or inclosed within a sac-like covering (the perigynium). *Carex cephalophora* is the species most commonly found in Kentucky bluegrass seed.

ERGOT OCCASIONALLY FOUND IN COMMERCIAL BLUEGRASS SEED.

Claviceps purpurea (Fr.) Tul.

ERGOT.

This is a fungus growth affecting the grain (caryopsis) of many grasses. It is very common in the seed of redtop and other species of Agrostis, and occasionally occurs in bluegrass seed. The grain of the seed becomes elongated, extending beyond the glume and palea, attains about twice the length of the glume, and is club-shaped, straight, or, more commonly, somewhat curved. It is black, dull, and somewhat grooved lengthwise. (Fig. 35.)

FIG. 35.—Ergot (*Claviceps purpurea*) of Kentucky bluegrass: *a*, enlarged; *b*, natural size.

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